Research Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2021;11:2s:231-235.

Assessment of Dental Non-Metric Traits for Forensic Profiling: A Pilot Study

Neha Acharya[1] Rajesh G Babu[2] Pankti Patel[3*] Nirav Patel[4]

[1]PG Student, Institute of Forensic Science, Gujarat Forensic Sciences University, Gandhinagar, Gujarat, India.
[2]Associate Professor, Institute of Forensic Science, Gujarat Forensic Sciences University, Gandhinagar, Gujarat, India.
[3]PG Student, Department of Oral Medicine and Radiology, Ahmedabad Dental College and Hospital, Ahmedabad, Gujarat, India.
[4]Orthodontist at Teeth Care Centre Dental Hospital, Ahmedabad, Gujarat, India.

ABSTRACT

Background: Non-metric dental traits are features of dental morphology that show alteration in their appearance both within and between the populations. These traits seem to be controlled in part by genetics, so these can be successfully used in the description of the ethnicity, which can be helpful in the identification of the person through the dental records.

Keywords: Forensic dentistry, non-metric traits, profiling.

INTRODUCTION

In biology, morphology refers to structure and form. For teeth, morphology means different things to dental anthropologists [1]. In forensic investigation identifying the human remains is thought to be the first step and is crucial for further analysis.

The sex determination of the human skeleton is usually the initial step in the identification method as future ways for age and stature estimation area of Sex-dependent. The authenticity of sex determination depends on the fullness of the remnants, and therefore, the degree of sexual dimorphism inherent within the population. Once the entire adult skeleton is out there for analysis, sex will be determined up to 100% accuracy, but in cases of fragmented bones, which are usually found in mass disasters, obtaining 100% accuracy in sex evaluation is difficult, and it largely depends on the available fragmented bones of the skeleton. [2, 3, 4]

This characteristic feature of the tooth helps in sex and age determination in medico-legal cases. In anthropological excavations, the morphometric features of the tooth aid to determine the sex, age, food habits and race of the population and also help to understand the cave dweller/human evolution. [2, 5]

Carebellie Trait

Carabelli's trait is a Cingular derivative expressed on the lingual surface of the protocone. It shows a wide range of expression, from complete absence to a large free-standing tubercle that approximates the hypocone in size. [6, 7, 8, 9]

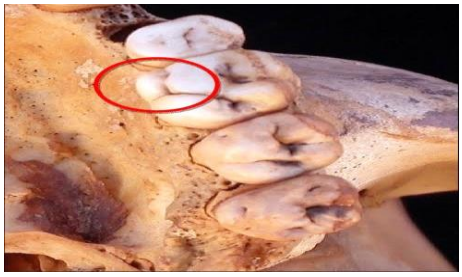

Fig 1: Showing cusp of carabelli's trait.

TUBERCULUM DENTALE: - Cingular projections on the lingual surface of the upper anterior teeth are relatively common in modern human populations and have a deep history in hominin and hominoid

Received: Dec. 29, 2020: **Accepted**: Feb. 1, 2021
*Correspondence Dr. Pankti Patel.
Department of Oral Medicine and Radiology, Ahmedabad Dental College and Hospital, Ahmedabad, Gujarat, India.
Email: patelpankti8@gmail.com

pISSN 2278-0076
eISSN 2321-9270

evolution. They typically take the form of ridges and/or tubercles. [10, 11, 12]

Fig 2: Showing Tuberculum Dentale.

SHOVELING: - Shoveling is part of the marginal ridge complex of the upper and lower anterior teeth. It involves the development of mesial and distal marginal ridges on the lingual surface. [13, 14, 15, 16]

Fig 3: Showing Shoveling in anterior teeth.

As masticatory forces exerted are diverse for males and females, the relative development such as strength, size, and angulations of the muscles of mastication is experienced to have a push on the expression of tooth dimorphism. [2, 17] The shape of the tooth can vary according to the different lifestyles and chewing habits. [2, 18] Therefore, the morphological characteristics of the tooth vary among different ethnic groups. There are several causes of differences in the shape of the tooth between the sexes. [2, 19] The shape and size of the mandible appear to differ between the sexes from the development of the deciduous tooth. The size of the tooth differs between males and females according to the stage of tooth development and muscle growth. Furthermore, the tooth has a different rate of growth in males and females. Because puberty occurs earlier in females than in males, sexual differences may manifest themselves in the skull and jaws of females earlier than in the later and longer maturing males. The Hypothesis for the study for the determination of males and females' tooth, many attempts have been made with the help of metric standards. However, metric methods have their disadvantages by their requirement of a complete set of equipment. Using non-metric methods, Bass found that the shape of the tooth could be used to distinguish between males and females. The study of non-metric traits are required because of globalization of ethnic group, and new variations of non-metric traits are showing up which is an indication of impromptu research on the subject so could we can trace back the origin of new ethic groups. All of the already done work shows the majorly seen non-metric dental traits are on molar, incisors and canine, and also, these teeth are less likely to change their morphology by natural wear and tear.

Aim

The purpose of this study was to determine the prevalence and variability of three non-metric dental crown traits (Carabelli cusp, tuberculum dentale and shovelled incisor) in the ethnic Gujarati Population and to compare these frequencies with the literature.

Objective

To assess the prevalence rate of a non-metric trait in the Gujarati population.

To assess the correlation between the non-metric trait and gender.

MATERIAL AND METHOD

Fig 4: Picture courtesy from National Forensic Science laboratory showing equipment used for the process such as stereomicroscope for accurate and better vigilance, laptop to be connected with microscope, cast and basic diagnostic tools of Dental.

Study Designs:

Qualitative retrospective study.

Method:

This study was undertaken on 109 undamaged human maxillary casts of known sex and age group 14 – 22 years old from a local dental clinic. Out of 109 samples, 48 samples are male, 61 are female and were examined for the morphological variations of maxillary central incisors, canine and 1st molar. All teeth crown traits were observed as per the modified ASUDAS method. Variability was recorded according to Grade- 1 = presence of trait, 0 = absence of a trait.

The visual examination made macroscopically in a room with natural light. To avoid potential eye strain of the viewer that would compromise the following observations, short breaks (5min) were taken between each assessment during data collection.

Table 1: Describing the Inclusion and Exclusion Criteria used for the study.

Inclusion criteria	Exclusion Criteria
All examined teeth were present	Deformed cast
No prosthesis	Deficiently poured cast
No restoration	Missing tooth
Well maintained poured dental cast	Carious tooth

The Data is charted in M.S excel male and female are charged differently age and sex of the sample cast were known, SPSS software is used to evaluate the P-value for significance for prevalence in male and female.

RESULT

The principal objective of this research was to observe the existing relationship of the non-metric dental crown traits studied between male and female permanent dentition; analysis of the expression of the maxillary Non-metric dental crown traits in both sexes determined that sexual dimorphism did not exist in male and female permanent teeth.

Table 2: Prevalence of dental crown trait in Gujarati Population.

Variable	Present n (%)	Absent n(%)
Carabelli trait		
Males	26(54)	22(46)
Females	25(41)	36(59)
Shovelling		
Males	29(61)	19(39)
Females	43(70)	18(30)
Tuberculum Dentale		
Males	20(42)	28(58)
Females	26(43)	35(57)

Total no of samples were109 out of which 61(56%) were females, and 48(44%) were male

Table 3: Correlation between non metric trait and gender.

Variable	Mean±SD	Significance (P-Value)
Carbellie Trait	0.47±0.501	0.174
Tuberculum Dentale	0.42±0.496	0.92
Shovelling	0.66±0.476	0.274

Independent variable: Gender P Value<0.05 was considered statistically significant. Development of non-metric trait is not gender dependent.

DISCUSSION

Non-metric dental crown traits are phenotype forms of the enamel, inherited and Controlled in their location, growth and orientation, resultants of indirect processes of mineral secretion mediated by proteins during the dental morphogenesis, and expressed and regulated by the human genome of any individual or population.

A study was conducted in Kerala to determine the frequency and variability of possible non-metric tooth traits using extracted permanent posterior teeth for discerning racial ethnicity. The more common features on premolars were multiple lingual cusps (31.21%), distal accessory ridges (16.28%) and Tom's root (17.9%). In upper first molars, trait expression was 17.78%, and other common features included met aconulo, cusp five and enamel extensions.[21]

Whereas this study conducted on the ethnic group of the Gujarati population to determine the frequency of three non-metric traits (shovelled incisor, carabellie trait, tuberculum dentale) to narrow down the search parameters.

A study on the living population of Colombia analysis of the expression of the three Non-metric dental crown traits in both sexes determined that sexual dimorphism did not exist in deciduous and permanent teeth, and it did exist bilateral symmetry of the features in the temporary and permanent dentitions.[20] whereas in the current study, only permanent dentition undertook for sexual dimorphism, and the parameters differ according to Gujarati populations.

Using non-metric characteristics of the mandible in sex determination and it was found Male mandibles showed rocker-shaped predominantly (58.9%), whereas about (41.1%) of female mandibles exhibited a straight inferior border of the mandible. The shape of the chin in most of the males was bilobate (45.5%), square (43.6%), whereas the female mandible had a pointed chin (71.4%). Shapes of the coronoid process observed were hooked in (27.8%), rounded (31.1%), and triangular (41.1%) with $P < 0.05$, which indicated statistical significance.[2]

In the year 2020, Dental college of Vadodara using dental non-metric traits in a mixed group of population, they also found no sexual dimorphism. But they found Carabelli trait prevalence more in males than in females. The present study also supports this that carabellie trait is more prevalent in males because of genes and morphological features. As we found that the development of non-metric trait is not gender dependant, but there are other ontological parameters available for sexual dimorphism.

CONCLUSION

Dental non-metric traits are the non-invasive methods for the identification of the individual. They also aid to create a unique identity for the person. As every individual has a unique arrangement of teeth, but it also has some features of both parents as of the DNA sequencing in similar manner, teeth of every individual are unique at the same it also comprises of both traits of parents and their ethnicity. Whereas in the present study, it was not found there is a differentiation of gender on the basis of non-metric traits. But there is a need for continuous research on the non-metric traits if at all due to increased globalization, any particular trait starts proliferating.

Future Prospects:

- Large number of sample size.
- More traits to be included in study model.
- More number of ethnic groups should be compared.
- Inter and Intra comparison of ethnic groups.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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